Space Weather Technical Forecast

Issued on Thursday 5 December 2024 at 00:53 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-class flares likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate, peaking at M2.3 at 04/1000 UTC from a region just beyond the east limb. At 04/2045 UTC a doubled peaked flare occurred, reaching M1.4 from AR3916 followed by the unnumbered region closely following behind on the southeast limb.

There are currently nine sunspot regions on the Earth-facing disc. AR3905 has rotated of the disc since the previous issue but may still contribute to a risk of flares within the next 24 hours. AR3906 is continuing to approach the southwest limb, becoming increasingly hard to analyse, but still remains one of the most complex regions on the disc. AR3912, now reaching the south-centre disc remains relatively a simple bipolar group, perhaps with some slight decay in the trailing spots in recent imagery. Going forward, the more notable regions are likely to be the regions rotating on from the southeast limb, and with the westernmost of these numbered AR3916. These remain very difficult to assess accurately due to their proximity to the limb, but show some potential for complexity which may become more apparent as they move into a less oblique viewing angle. Other spot groups are largely small, simple and inactive.

No Earth-directed CMEs have been observed, however there are a number of filaments on the Earth-facing disc, including a large north-south filament on the east disc, which will be monitored for any potential lift off. A small filament lifted of from the northeast quadrant beginning around 04/0400 UTC, although little ejecta appears present on any coronagraph imagery. A small slow CME can be seen in imagery in association with the M2.3 flare in the southeast, but looks to be directed to the east of the Earth-Sun line.

Solar Wind / Geomagnetic Activity: Solar wind speeds were predominantly slightly elevated and showed a gradual, albeit erratic, rising trend through the period, with a brief peak of 520km/s, however, solar wind speeds have been gradually trending downwards in the last few hours. The density was around average. Interplanetary Magnetic Field (IMF) strength, Bt, began as Moderate gradually becoming weak by the end of the period, around 10nT before 04/0300 UTC. The north-south (Bz) component was Weakly variable between +8nT and -6nT. The Phi angle remained steadily negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background.

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The associated 24-hour fluence was below Active. The 05/0000 UTC observation was 1.08e6 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Mostly Low activity is expected with further isolated M-class flares likely.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. There are no coronal holes fast wind connections expected through the period, with slightly elevated winds easing to be mainly background. Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

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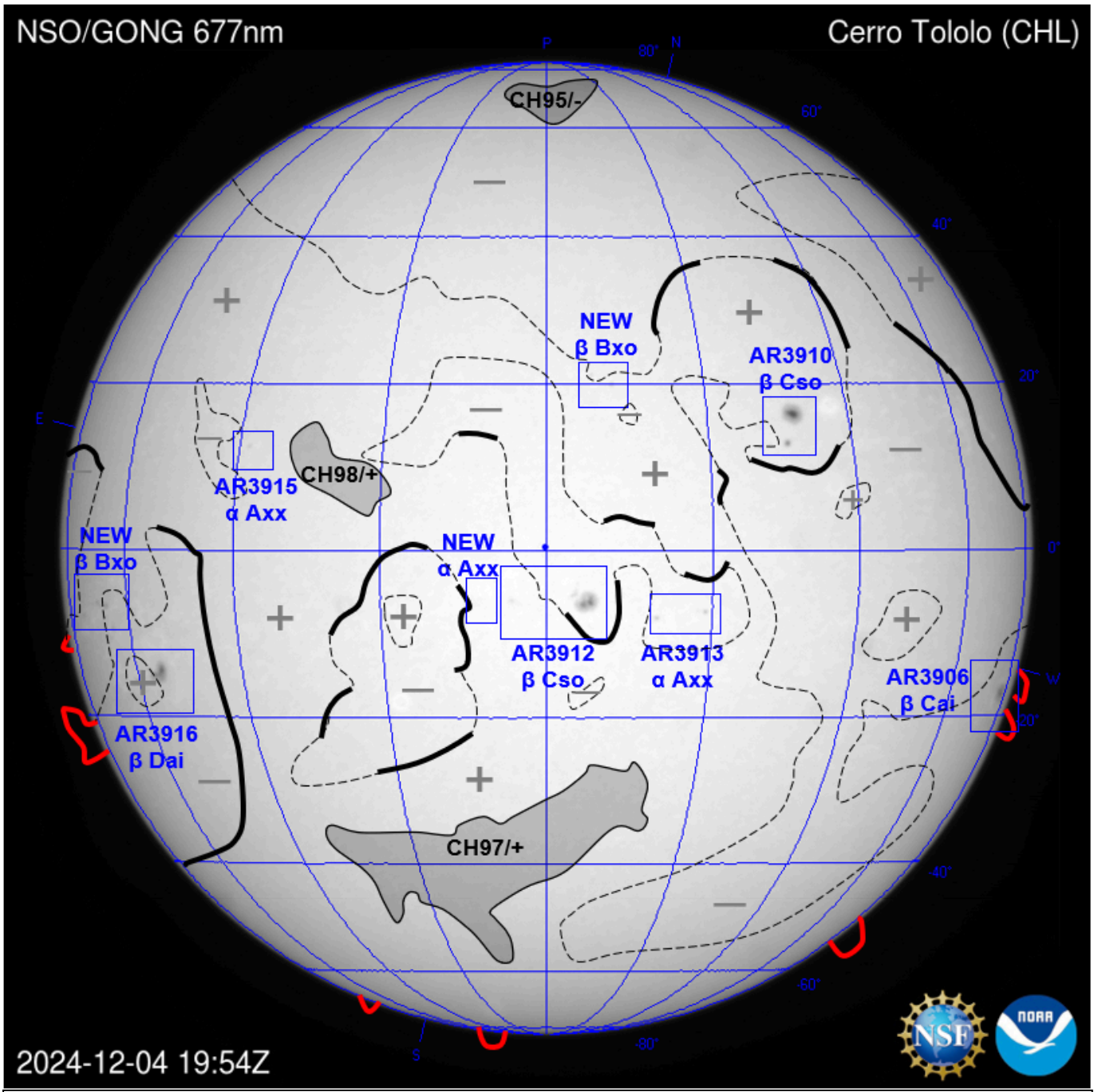
Figure 1: Solar Synoptic Map valid 04/1954 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs. However there are a number of filaments on the Earth-facing disc, including a very large north-south orientated filament in the east, close to two relativity complex sunspot regions. This will be monitored as it moves more into the Earth-Sun line later in the period.

Slightly elevated solar winds at first with speeds around 450km/s, this is expected to ease a little to become background, generally below 400km/s. Current solar wind speeds in MOSWOC Enlil are underdone compared with reality but are expected to be too fast from the 05 Dec due to Enlil's idea of connecting to a high speed stream from CH97+. However, CH97+ looks too far south in reality to cause any enhancement, CH97+ is also a persistent feature from the previous rotation and had no perceptible influence on the observed solar wind. Hence Enlil is viewed with low confidence. CH98+ is currently too far east to bring any geomagnetic enhancement during this forecast period.

Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	1	1	1	1
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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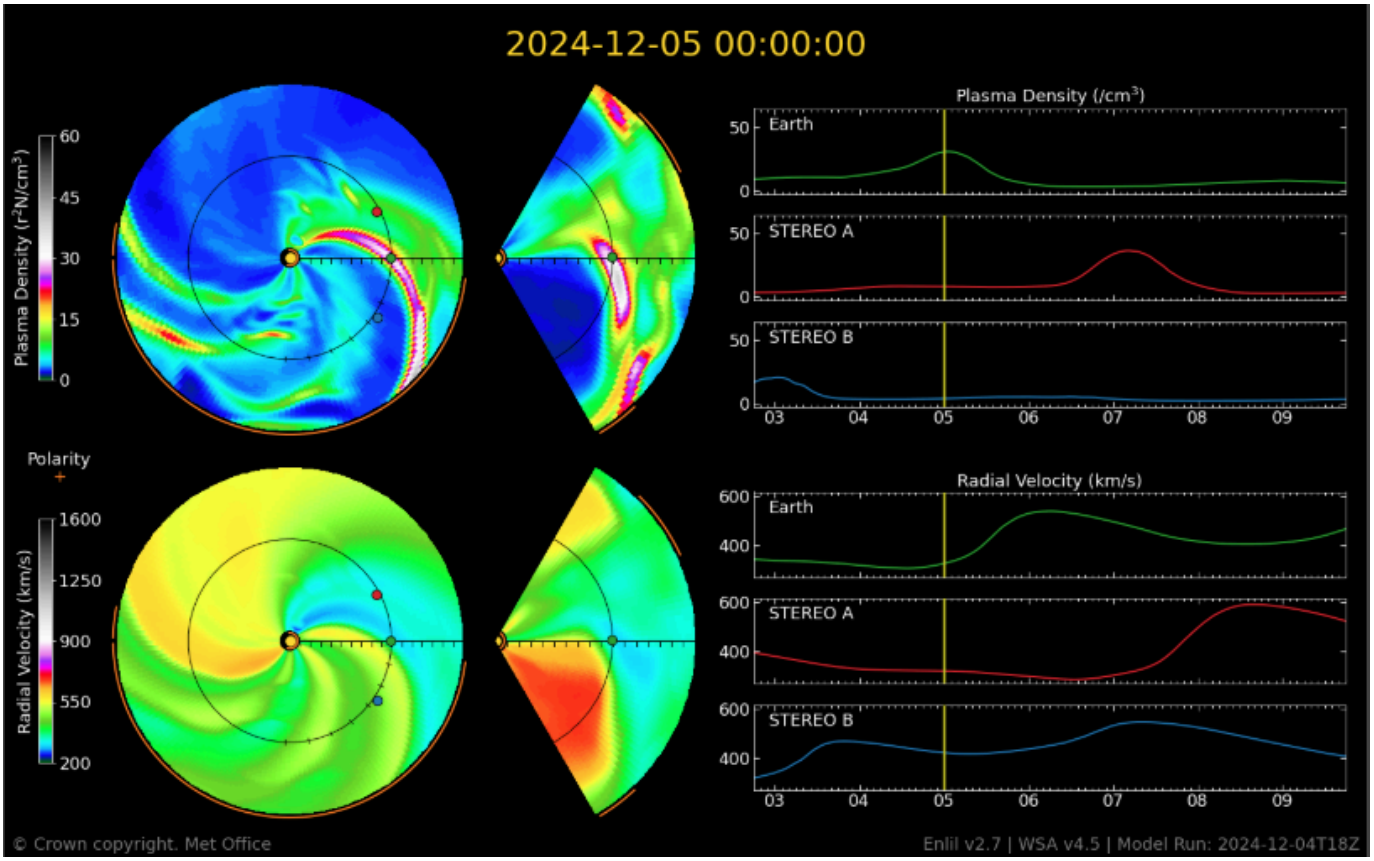
Figure 2: MOSWOC Enlil showing spurious connection to HSS enhancement from CH97+.



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Radio Blackouts - X-Ray Flares

There are currently nine sunspot regions on the Earth-facing disc. AR3905 has rotated of the disc since the previous issue but may still contribute to a risk of flares within the next 24 hours or so. AR3906 is continuing to approach the southwest limb, becoming increasingly hard to analyse, but still remains one of the most complex regions on the disc. AR3912, now reaching the south-centre disc remains relatively a simple bipolar group, perhaps with some slight decay in the trailing spots in recent imagery. Going forward, at least two potentially magnetically complex regions are rotating onto the disc from the southeast limb, these associated with notable magnetic looping as can be seen on imagery. The westernmost of these numbered AR3916 looks to have produced a recent M1.3 flare around 04/2045 UTC shortly followed by a M1.4 from the currently unnumbered sunspot region just coming around the southeastern limb. These remain very difficult to assess accurately due to their proximity to the limb. Other spot groups are largely small, simple and inactive. SDO imagery remains unavailable, with the current analysis based primarily off lower resolution GONG 677nm and Magnetogram imagery, lowering the confidence in these assessments. This imagery outage is likely to continue into 2025.

Low to Moderate activity is forecast, with further isolated M-class flares likely.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES16/18 X-ray flares. Showing a peak of M2.3 at 04/1000 UTC.

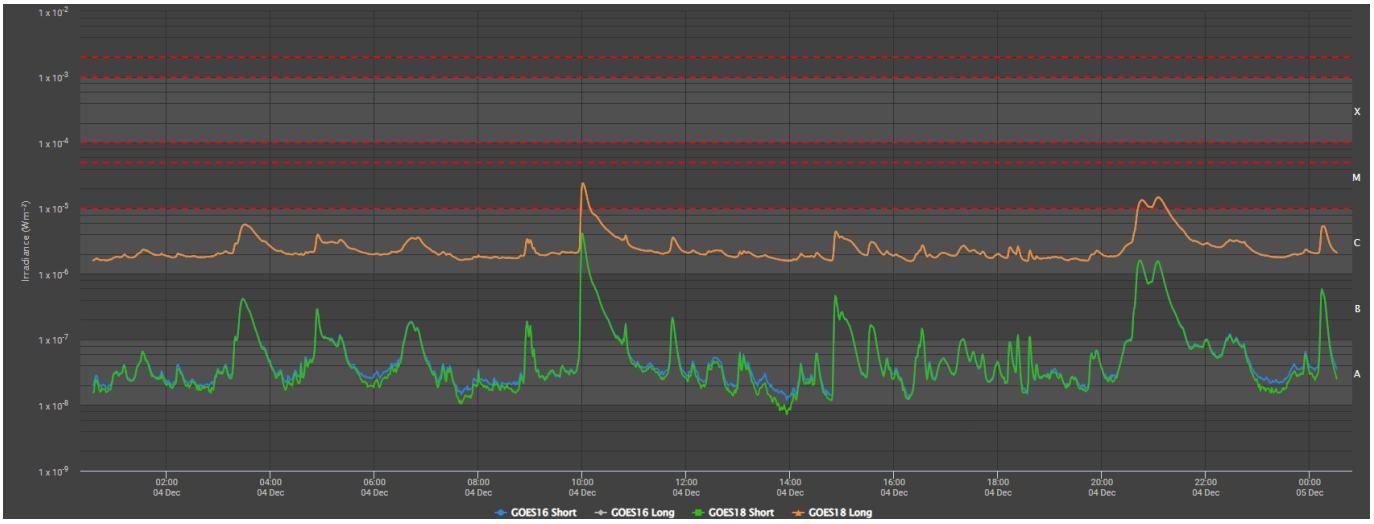

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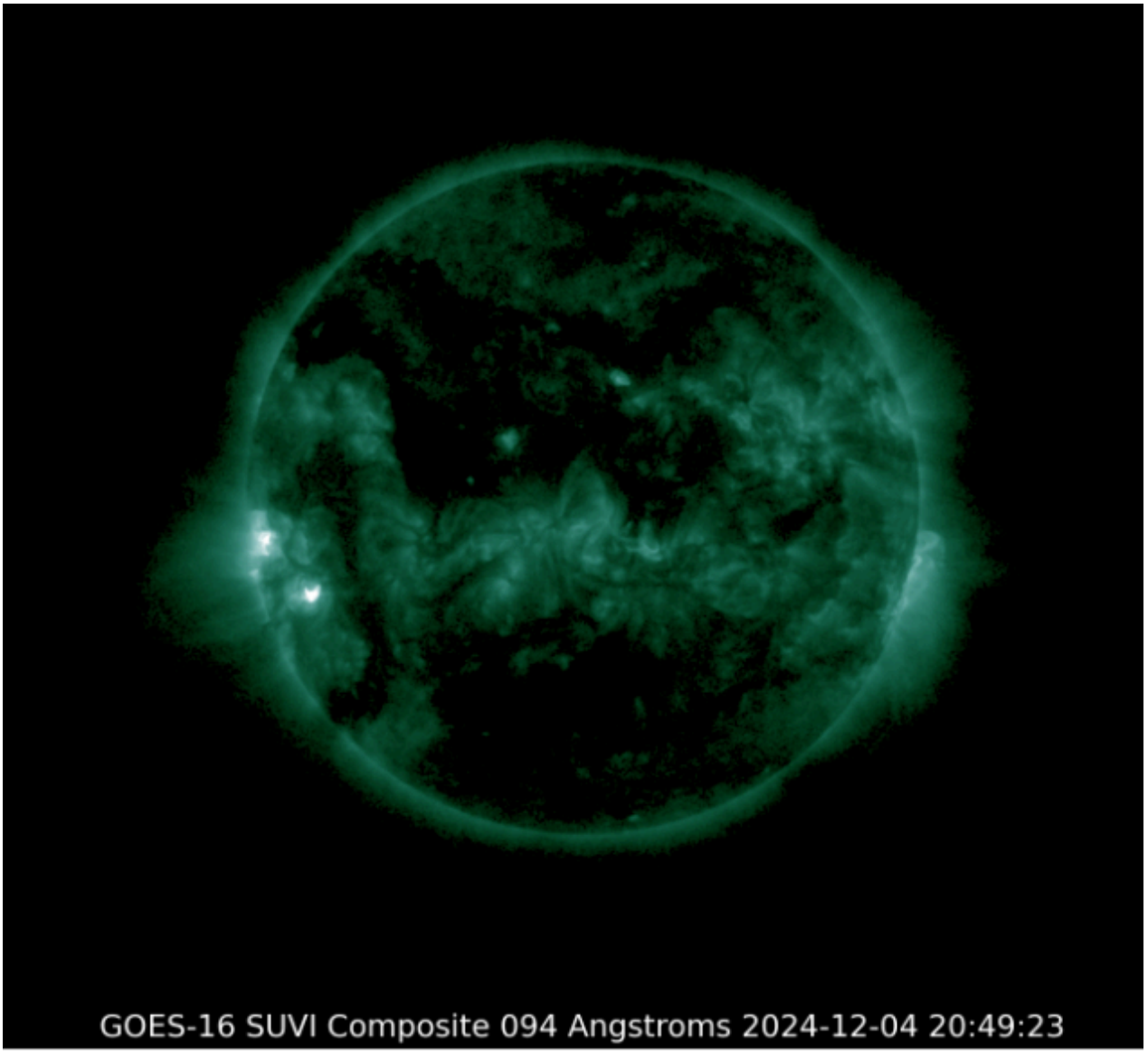
Figure 4: GOES16 SUVI 094 showing flare activity on the southeast limb.



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Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a very slight chance of high energy proton enhancement through this period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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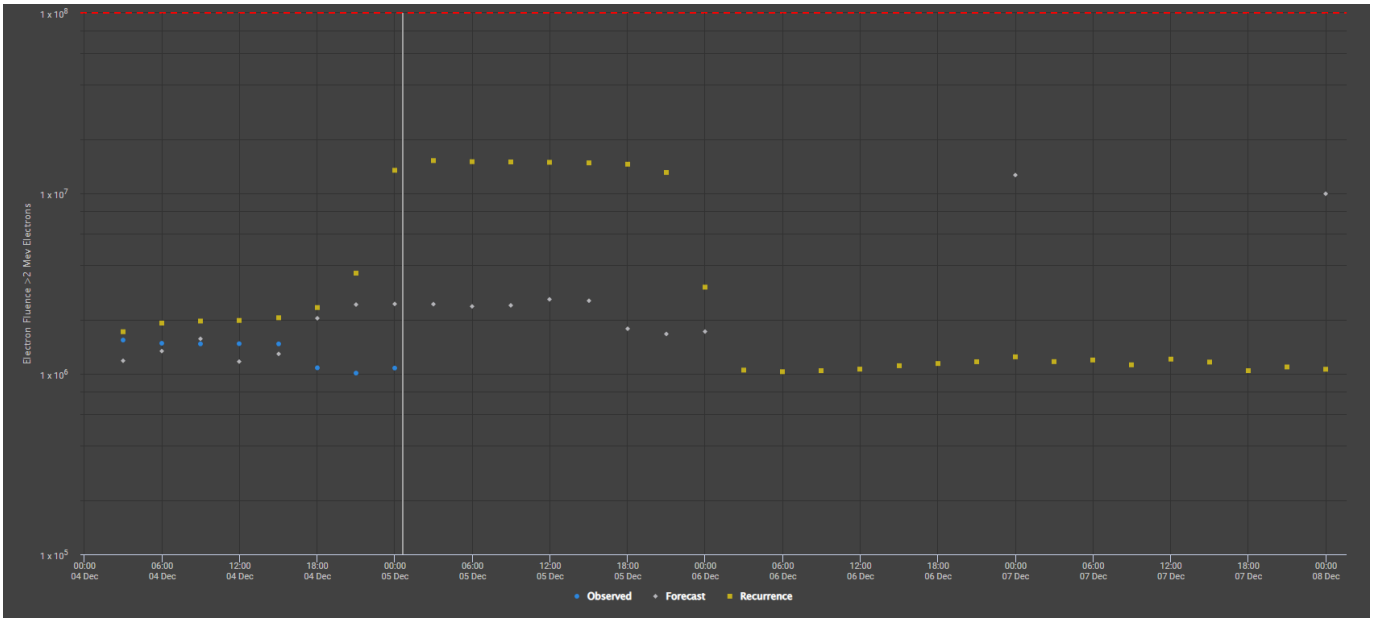
High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: Latest MOSWOC REFM output



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